Fall 2024

MTH642 Fluid Mechanics

Assignment No 1

Total Marks = 35

Due Date: 27th December 2024

DON'T MISS THESE: Important instructions before attempting the solution of this assignment:

- **Listen the lectures and consult the recommended book for the clarification of concepts**
- **Upload assignments properly through LMS, No Assignment will be accepted through email.**
- **Write your ID on the top of your solution file.**
- **Don't use colorful back grounds in your solution files.**
- **Always send your solution in dox or docx file with proper accessible math type symbols.**
- **You should remember that if we found the solution files of some students are same then we will reward zero marks to all those students.**
- **Also remember that you are supposed to submit your assignment in Word format any other like scan images etc will not be accepted and we will given zero marks.**

Question No 1: **Marks=10**

Air whose density is 0.082 lbm/ft^3 enters the duct of an air conditioning system at a volume flow rate of 450ft^3/min. If the diameter of the duct is 16 inches, determine the velocity of the air at the duct inlet and the mass flow rate of air.

Question No 2: **Marks=10**

A steady, three-dimensional velocity field is given by

$$\vec{V} = (0.657 + 1.73x + 0.948y + az)\hat{i} + (2.61 + cx + 1.91y + bz)\hat{j} + (-2.73x - 3.66y - 3.64z)\hat{k}$$

Calculate the constants *a* ,*b*, *c* such that the flow field is irrotational.

Question No 3: **Marks=10**

The continuity equation in cylindrical coordinates for steady flow is given by:

$$\frac{1}{r}\frac{\partial(ru_r)}{\partial r} + \frac{1}{r}\frac{\partial(u_\theta)}{\partial \theta} + \frac{1}{r}\frac{\partial(u_z)}{\partial z} = 0$$

Write the primary dimensions of each additive term in the equation and verify that the equation is dimensionally homogeneous.

Question 4: **Marks=05**

Using primary dimensions, verify that the Archimedes number is dimensionless. The Archimedes number is given by the formula:

$$Ar = \frac{\rho g L^3}{\mu^2}$$

Where:

- ρ is the density of the fluid
- g is the acceleration due to gravity
- L is a characteristic length
- μ is the dynamic viscosity of the fluid